

## **2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES**

This chapter describes the Proposed Action and the No Action Alternative. The Proposed Action consists of DOE's decision to provide partial funding for two components of a geothermal system, a proposed power plant and a direct-use application. To present the reader and decisionmaker with a means of comparison, this EA discusses effects of the proposed power plant and direct-use application together and separately where appropriate. Since the Proposed Action consists of potentially adding a new small-scale geothermal power plant and a direct use application to an existing system that uses geothermal energy to heat water for the tilapia hatchery, the existing facilities are described in detail. The No Action Alternative is described in Section 2.4.

### **2.1 LOCATION**

The proposed project would be located in the eastern half of Section 6 and in Section 7, Township 25S, Range 19W, Hidalgo County, NM, approximately 16 miles (26 km) southwest of Lordsburg, and just north of Animas and Cotton City (Figure 1-1). The project is within the Lightning Dock KGRA (Figure 1-2).

### **2.2 EXISTING FACILITIES**

AmeriCulture currently operates a commercial tilapia fish hatchery. The hatchery facilities include 33,000 ft<sup>2</sup> (approximately 3,100 m<sup>2</sup>) of converted greenhouse space on 15 acres (6 ha) of private land; large fish breeding tanks and tanks where mature fish are kept with a total volume of 170,000 gallons (640,000 l); a 1,200 ft<sup>2</sup> [110 m<sup>2</sup>] small office/shop; and some small storage space (see Figures 2-1 and 2-2).

The fish require warm fresh water. The fresh water is supplied via an existing pipeline from an existing well approximately 8,500 ft (2,600 m) to the west (Figure 2-3 and 2-4). After circulating in the fish tanks, the water is filtered and recycled. The wastewater left over from the filtration is pumped through a pipe to a containment pond just west of the greenhouses where it evaporates. The amount of freshwater used varies according to the season. The average use is 50 gallons per minute (gpm) (190 liters per minute [lpm]). In a separate closed loop, water is circulated through a downhole heat exchanger in a geothermal well (AmeriCulture State 1) just to the southeast of the hatchery facilities. The water is heated in the exchanger and pumped to the hatchery and is used to maintain the required temperature for the fish tanks. The water is then recirculated back to the downhole heat exchanger. At this time, no geothermal fluids are pumped to the surface at AmeriCulture.

The existing geothermal well (AmeriCulture State 1) is located to the southeast of the hatchery. It is a 400 ft (122 m) deep 10.75 in (27.3 cm) diameter well that is cemented down to 282 ft (86 m). It is expected that the well can deliver more than 1000 gpm (approximately 3,800 lpm) at 232°F (111°C) (Witcher 2001). Depth to water is approximately 75 ft (23 m). The temperature in the well with the heat exchanger in place has been measured at 232°F (111°C). A 48-hour flow test was conducted in October 2000, which showed a

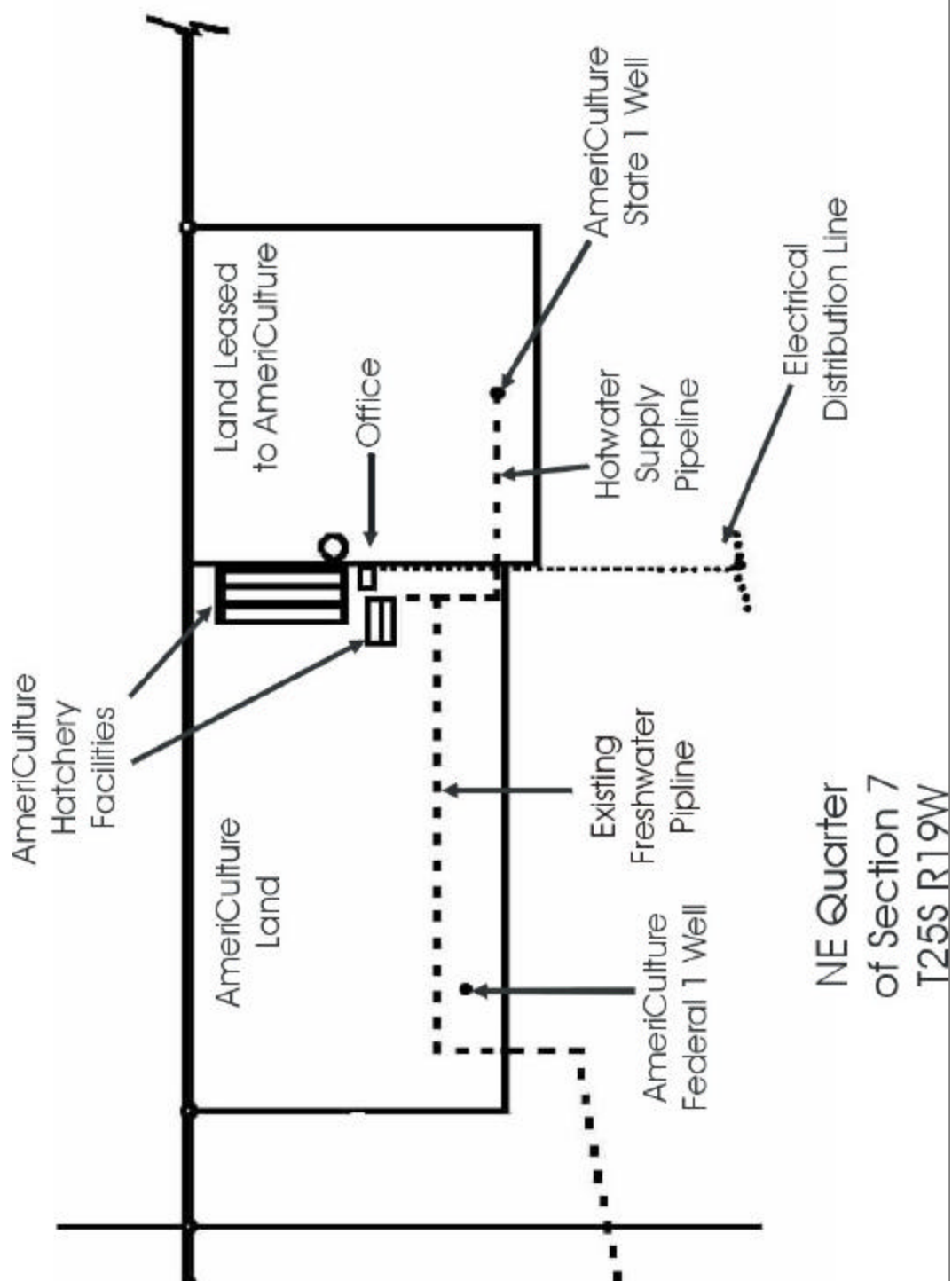
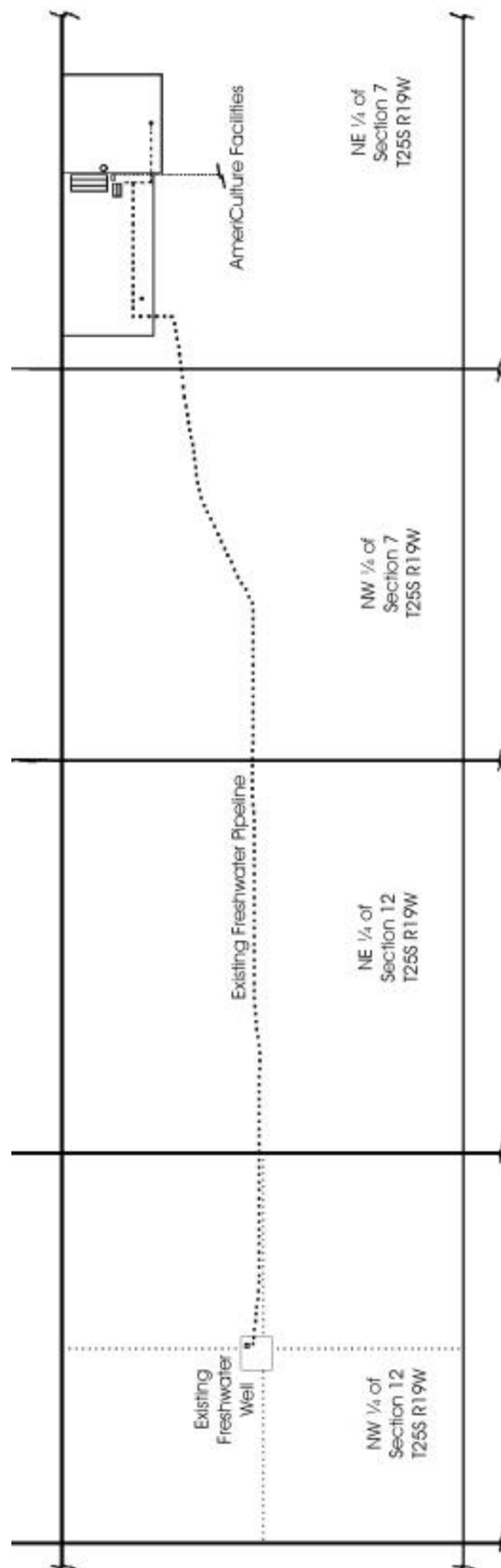


Figure 2-1. AmeriCulture's Existing Facilities.

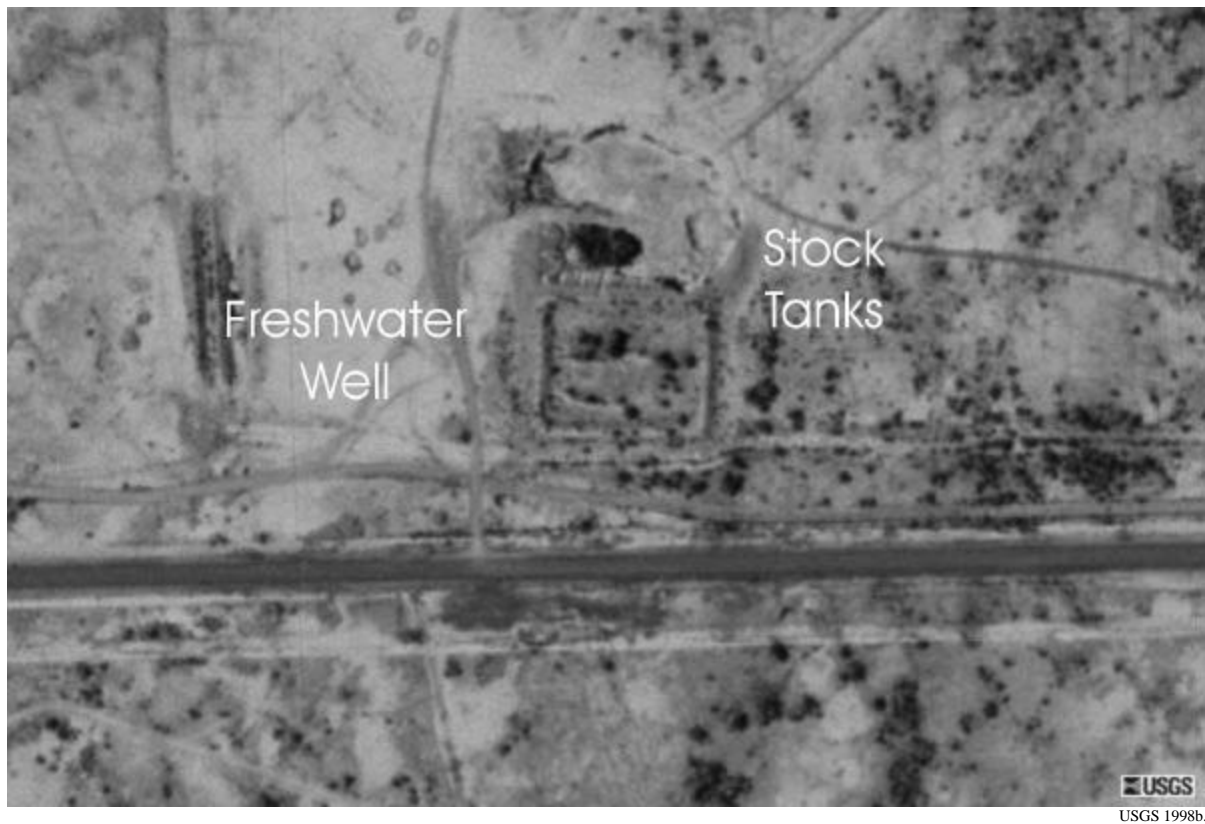


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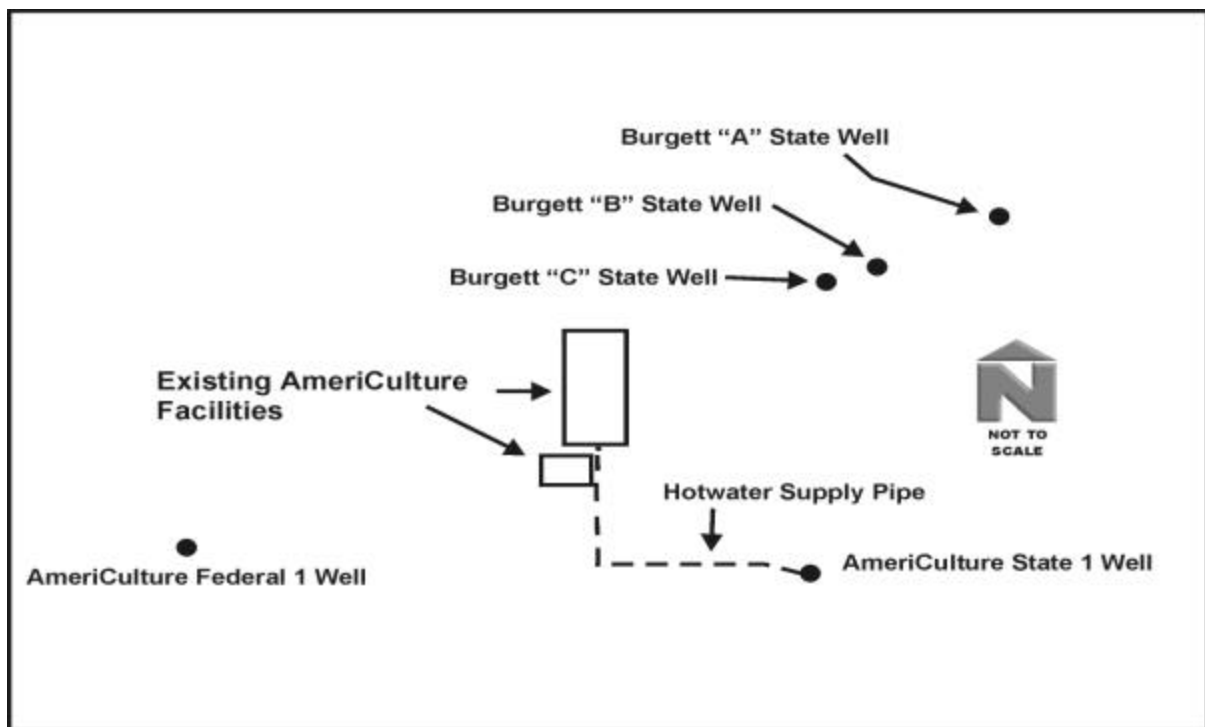
**Figure 2-2. Aerial Photograph of Location of Proposed Action.**



**Figure 2-3. Existing Freshwater Well and Pipeline to AmeriCulture Facilities.**



**Figure 2-4. Aerial Photograph of Existing Freshwater Well Site.**



**Figure 2-5. Pump Test Wells.**

sustained rate of 1,050 gpm (approximately 4,000 lpm) or greater. The stable production temperature was 232°F (111°C). The heat exchanger was removed prior to the flow test. The water quality of the geothermal fluid is considered good with a total dissolved solid (TDS) of approximately 1,050 parts per million (ppm).

Other wells in the immediate vicinity include an AmeriCulture geothermal well (AmeriCulture Federal 1) to the west of the hatchery, which is unused, and the Burgett wells (Burgett “A,” Burgett “B,” and Burgett “C”) to the east (Figure 2-5), which supply geothermal fluid used to heat the Burgett greenhouses and produce power in Burgett’s turbine/generator.

The Columbus Electric Cooperative, Inc., a member of the Tri-State Generation and Transmission Association, Inc. (Tri-State), currently supplies electrical power at AmeriCulture. Columbus Electric interconnects with Tri-State at Deming and Playas, NM (see the discussion of infrastructure in Section 3.6).

## **2.3 PROPOSED ACTION**

The Proposed Action is for Exergy, Inc., in association with AmeriCulture, Inc., to develop two components of an integrated geothermal system. The first component (see Section 2.3.1 below) is an average 1,280 kW gross (1,000 kW net) Kalina Cycle geothermal power plant at the AmeriCulture facilities. This power plant would utilize geothermal fluid from the existing geothermal well (AmeriCulture State 1) to generate power. The power would be used by AmeriCulture or neighboring industry. The second component of the Proposed Action (see Section 2.3.4 below) is a direct-use application would be constructed. to utilize the geothermal fluid exiting the proposed power plant to heat the water for the fish tanks. If for any reason the power plant (first component) was not constructed the direct-use application (second component) could still be built. In this case the direct-use applications would use the geothermal fluid straight from the existing geothermal well (AmeriCulture State 1). The spent geothermal fluid would be reinjected in a new well that would be drilled north-northeast of the AmeriCulture site (Figures 2-6 and 2-7).

### **2.3.1 Proposed Power Plant**

The proposed power plant would be constructed within a 0.6 acre (approximately 0.2 ha) area approximately 80 ft by 300 ft (24 m by 91 m) on the AmeriCulture site just south of the existing hatchery facilities (see Figure 2-2). The proposed power plant would be constructed along the pathway of the existing heated water pipeline between the AmeriCulture State 1 geothermal well and the hatchery. The geothermal fluid for the power plant would be pumped from the existing well (AmeriCulture State 1). The production from the well is expected to be about 1,000 to 1,200 gpm (3,800 to 4,500 lpm) at 232°F (111°C). A new pipeline for the geothermal fluid would be installed along the existing heated water pipeline. The geothermal fluid exiting from the proposed power plant is expected to be thermally depleted to a temperature of approximately 140°F (60°C). This depleted geothermal fluid would used to heat the fish tanks. Once the new geothermal fluid heating system is installed the old heated water pipeline would be removed.

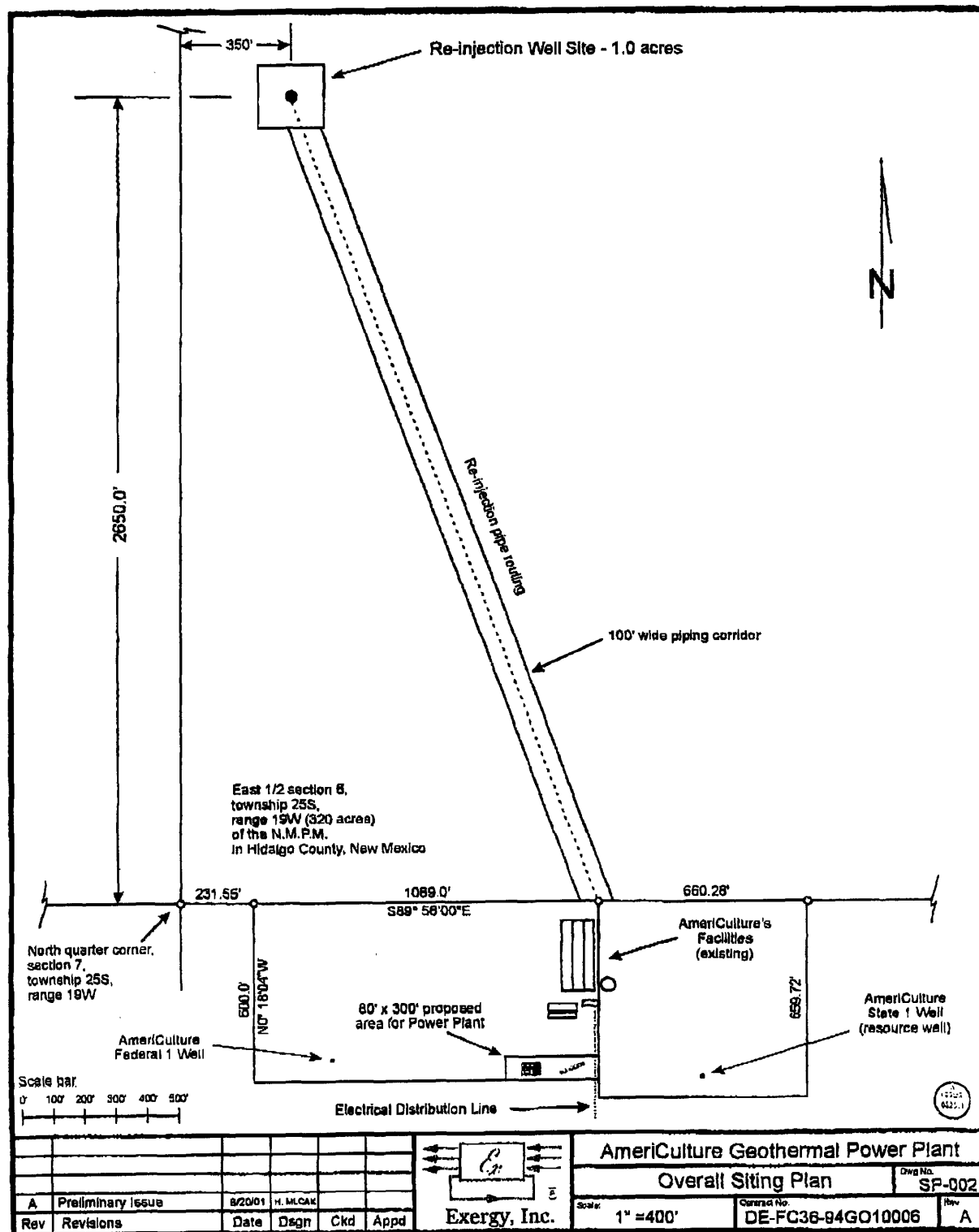


Figure 2-6. Location of Elements of Proposed Action at AmeriCulture.



**Figure 2-7. Location of Power Block and Pipelines on the Site Aerial Photograph.**



The power plant would be designed to use the Kalina Cycle process. The Kalina Cycle process uses a working fluid of ammonia and water in a closed loop arrangement. The power plant would use the heat from the geothermal fluid to vaporize the ammonia-water working fluid in a heat exchanger. The vapor would drive a turbine generator. Figure 2-8 shows the layout of the power plant. The "power block" occupies an area of approximately 40 ft by 60 ft (12 m by 18 m). The power block includes the evaporator-condenser assembly, the turbine-generator skid, separator, feed pump, blowdown tank, water storage tank, ammonia storage tank, and the control building. The turbine would generate 85 dBA of noise at 3 to 5 ft (0.9 to 1.5 m). The ammonia storage capacity that is anticipated for this project would be a single tank that would have a volume of 2,000 gallons (approximately 7,600 liters) or less. The tank would be surrounded by a berm high enough to contain any spill.

The Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA) require the reporting of hazardous chemical leaks. Reportable releases of ammonia usually have to be reported to three different governmental agencies: federal, state and local. All three must be notified immediately following a reportable spill or release. Any time ammonia is spilled or released to the outside in excess of its reportable quantity, 100 lbs per 24 hrs, immediate reports must be made to various government agencies.

Anhydrous ammonia is a "hazardous chemical" for purposes of OSHA, which prescribes handling and storage requirements. Employees must be trained in its safe handling methods, and have material safety data sheets readily available. Storage of over 500 lbs of anhydrous ammonia must be reported to the Local Emergency Planning Committee. When the ammonia is mixed with water, the reportable quantity varies with the concentration of ammonia.

The mixture of two compounds with two different boiling points as the working fluid allows a better match to the temperature of the heat source and increased thermal efficiency. The relative concentrations of ammonia and water are varied throughout the process to also increase efficiency. The relative concentration can also be varied seasonally. Other geothermal power plants use a single compound working fluid such as isobutane, pentane, or ammonia. The higher efficiency of the Kalina Cycle would allow for greater plant capacity and energy output for the given heat source compared to other processes and lower capital cost.

The power plant would be designed to produce an average gross output of 1,280 kW. The power requirement for pumping the geothermal fluid from the well is expected to be approximately 75 kW. The power requirement for the cycle pumps, cooling water pumps, cooling tower fans, and other power plant equipment is expected to be approximately 205 kW. The remaining power (approximately 1,000 kW) from the proposed power plant would be available for use by AmeriCulture and/or a neighboring industry. This is enough power for approximately 860 homes (EIA 1997).

The power generated by the proposed power plant would be used by AmeriCulture, Inc. AmeriCulture anticipates that implementation of their current expansion plans would result in their power needs increasing to 1,000 kW within 2 to 3 years. At that point in time, AmeriCulture would be using all the power onsite that is produced by the power plant. Until

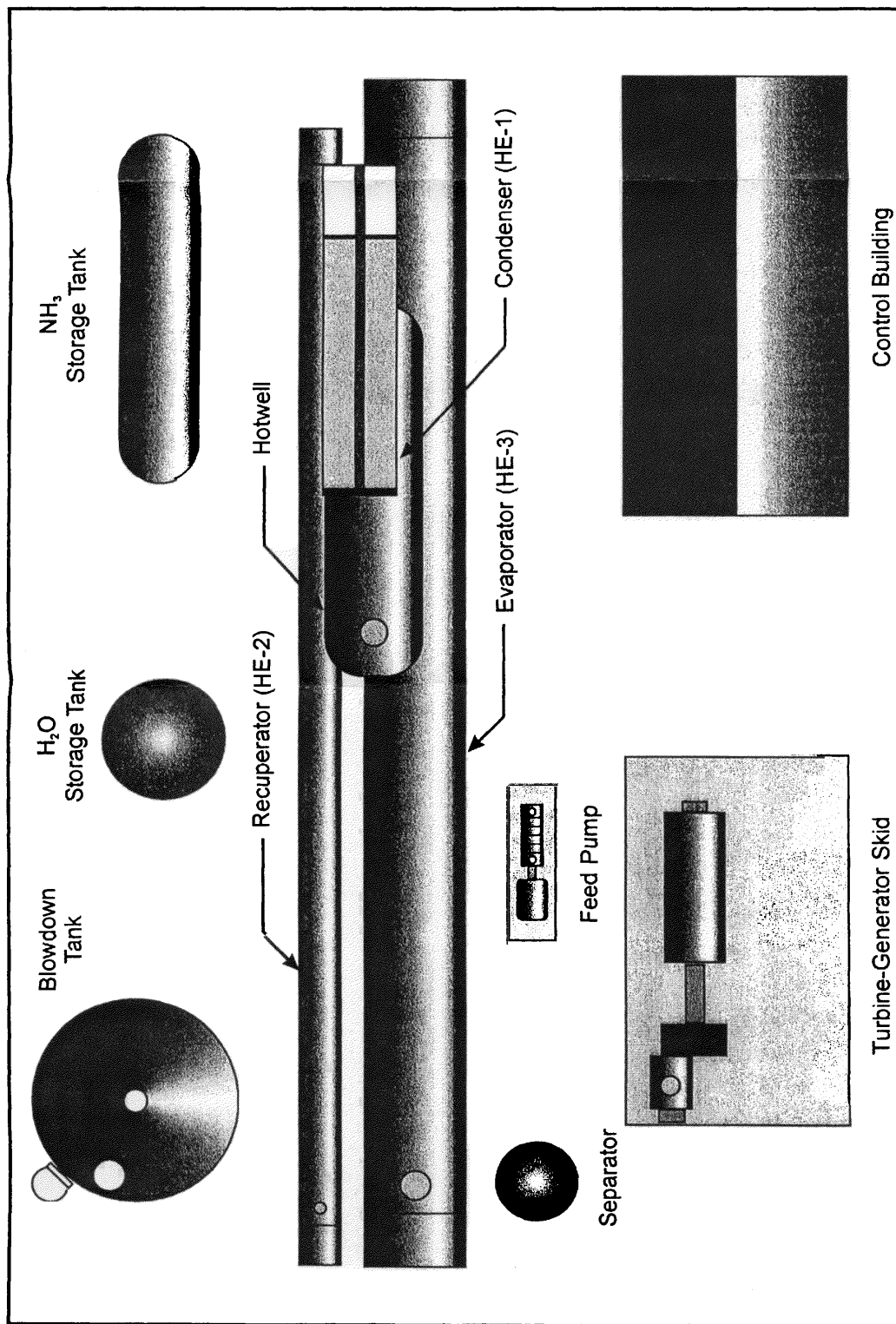


Figure 2-8. Proposed Turbine and Generator Layout

that point in time, any excess power would be sold to Columbus Electric. Columbus Electric is a member of Tri-State. The details under which that power would be sold to Tri-State have not yet been worked out. Any safety, switching, transformer, or quality of service equipment that would be needed would have to be provided by the generating entity. While the types and specifications of the needed equipment have not been detailed, the equipment would be located next to the proposed power plant, just to the west of the turbines.

The power lines connected to the AmeriCulture site may not need any upgrades to accommodate the transmission of the generated power, should any be sold to Columbus Electric. The need for upgrades would be dependent on the amount of power that would be transmitted. The existing lines provide a moderate capacity for transmission. Potential upgrades to the existing power lines could include replacement of the existing lines or addition of a new line. Bearing the costs of the new lines would likely be the responsibility of the generating entity and would also affect the decision on whether to sell power to Columbus Electric. It is anticipated that the replacement line or additional line would be strung on the existing poles.

Exergy and AmeriCulture would monitor and report data to the NREL to document the facility's technical and economic performance. The data would include well physical and chemical data, plant process thermal, mechanical, and electrical performance, plant reliability, availability and load factor, plant energy generation, and plant operation and maintenance costs.

### **2.3.2 Cooling Towers**

A cooling tower skid would occupy an area approximately 14 ft by 86 ft (4 m by 26 m), located just to the east of the proposed power plant (Figure 2-9). The cooling tower skid is oriented east-northeast along the prevailing wind direction. The cooling towers would be 25 ft (7.6 m) high. Similar cooling towers generate 85 dBA of noise at 3 to 5 feet. The cooling tower would use evaporative cooling to cool water circulated through a condenser that would condense the ammonia-water vapor exiting the turbine. The cooling tower would use fresh well water as makeup. The flow rate for this system is 100 gpm (approximately 380 lpm) into the cooling towers. After use in the cooling towers, the outflow rate of the blowdown water is 30 gpm (approximately 114 lpm). The blowdown water would have a temperature range of approximately 40°F to 75°F (4°C to 24°C) depending on the seasonal ambient air temperature. To supply the make-up water, a new second freshwater well would be drilled adjacent to the existing freshwater well. A new pipeline would be installed. The new pipeline would run next to the existing pipeline until it crossed into AmeriCulture property. At that point the new pipeline would continue north to the northern edge of the Americulture property and then turn east to the greenhouses. The new pipeline would bring the water for use in the proposed power plant for the cooling towers. The cooling tower blowdown would be mixed with the cooled geothermal fluid for reinjection.

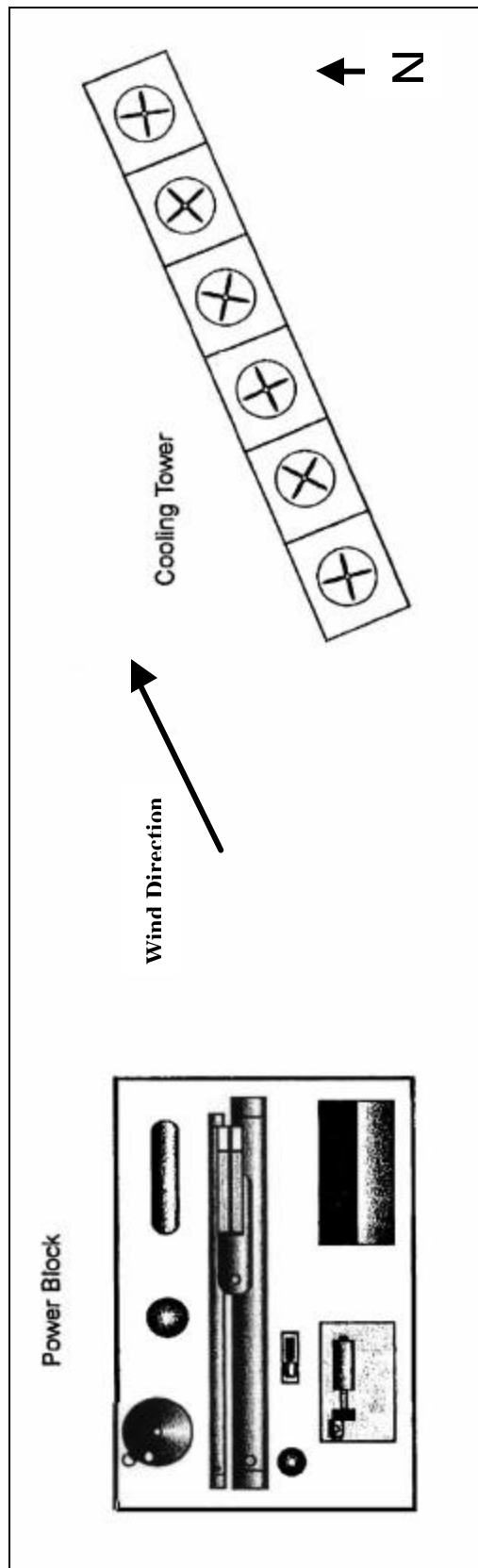


Figure 2-9. Proposed Power Block and Cooling Tower Layout

### **2.3.3 Changes to Existing Geothermal Well**

The existing heat exchanger would be removed from AmeriCulture State 1 and a Centrilift, or similar, pump installed. A new pipeline for the geothermal fluid would be installed along the existing heated water pipeline. The measured temperature of the geothermal fluid in the well was 232°F (111°C). The production from the well is expected to be about 1,000 to 1,200 gpm (3,800 to 4,500 lpm). Existing data from a recent flow test and nearby production wells indicate that the existing well would be adequate for the proposed power plant (Witcher 2001). The neighboring greenhouse producer has used nearby wells for over 15 years. Pumping rates have occasionally reached 2,000 gpm when thermal demand is maximum and their power plant is operational.

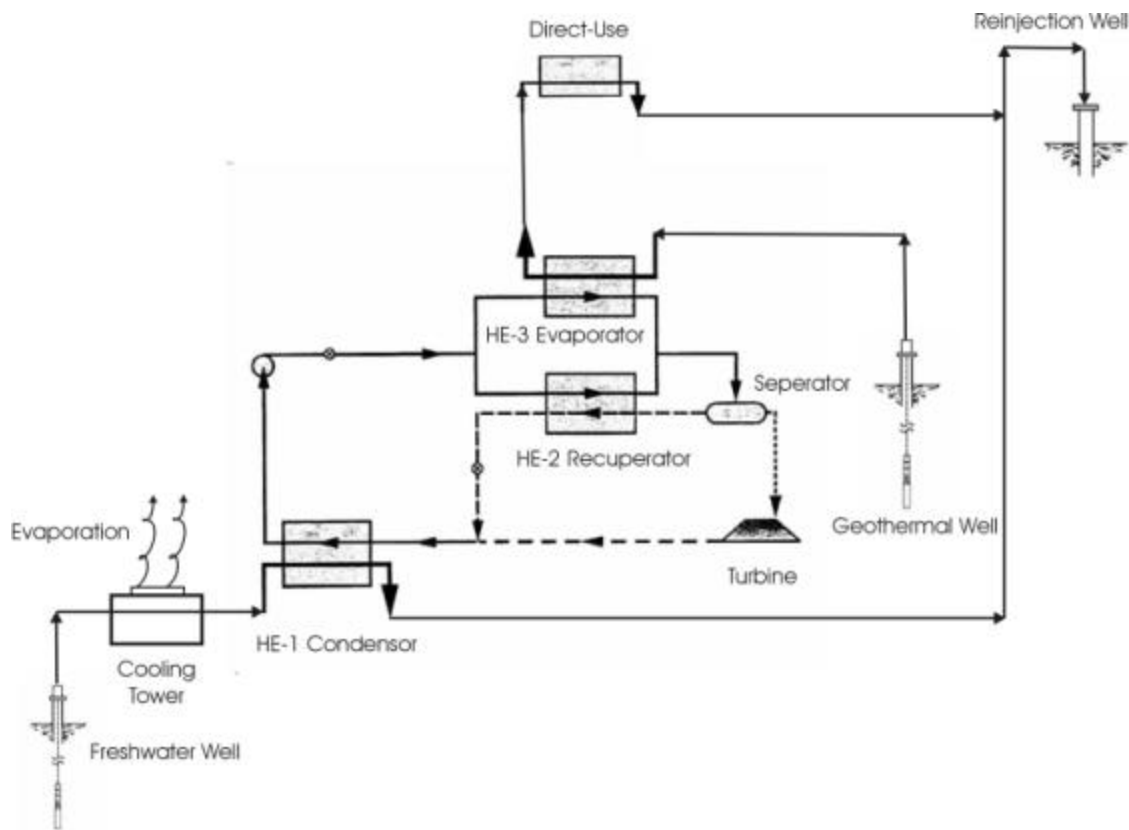
### **2.3.4 Direct Use of Geothermal Fluid**

While the Proposed Action is to develop the direct-use application in association with the proposed power plant, it could be implemented without the power plant. According to current plans, the direct-use application would use the 140°F (60°C) geothermal fluid exiting the power plant for heating the hatchery fish tanks. After use at the hatchery, the exiting geothermal fluid, cooled to approximately 100°F (approximately 38°C), would be mixed with the blowdown water and piped to the new injection well (detailed in Section 2.3.5) (Figure 10).

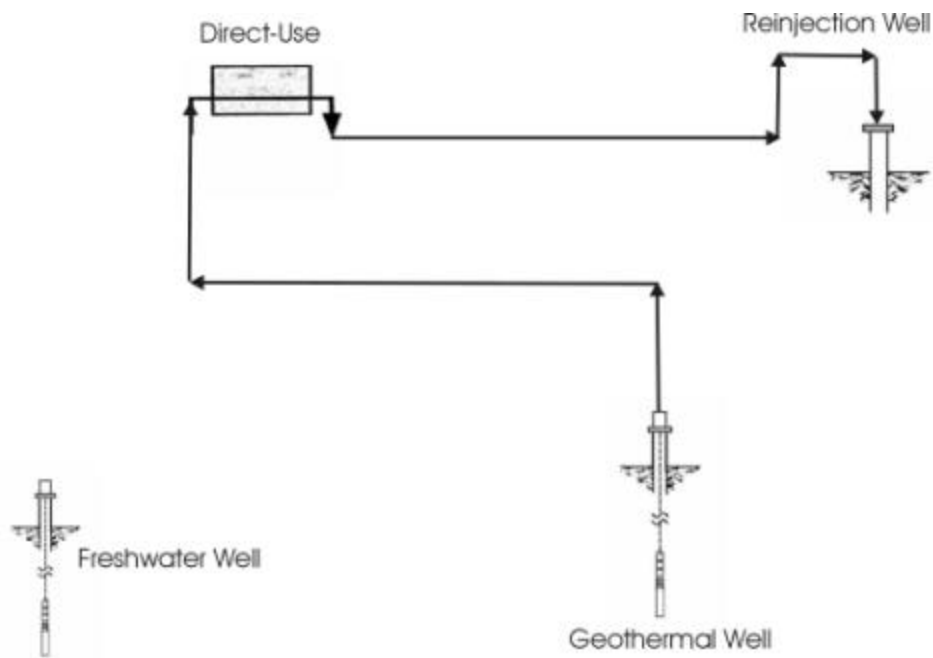
If the direct-use application were to be implemented without the proposed power plant, the 230°F (110°C) geothermal fluid from the AmeriCulture State 1 well would be used to directly heat the water for the fish tanks. In this case, the downhole heat exchanger in the AmeriCulture State 1 well would be removed and a pump would be installed to pump the geothermal fluid to the hatchery. This would allow for a greater amount of water to be heated to the required temperature. The geothermal fluid exiting the hatchery, cooled to approximately 130°F (54°C), would be piped away for reinjection in the same manner as described above (Figure 11).

The equipment would be the same for either direct-use possibility. The direct-use system must be capable of running on either the water discharged from the power plant (approximately 140°F [60 °C]) or directly from the ground (approximately 230°F [110°C]), because power plant downtime is inevitable and fish tanks must still be heated during power plant downtimes. Maintaining a pressure of between 30 to 50 pounds per square inch (psi) in the direct-use system prevents flashing. The control and variation of pressure is used across the geothermal industry to control the point in the system where the geothermal fluid would flash to steam.

Under either configuration, AmeriCulture would monitor and report data to the NREL to document the direct-use application's technical and economic performance. The data would include well physical and chemical data, thermal, performance, reliability, and maintenance costs.



**Figure 2-10. Flow Diagram for Both Components of Proposed Action.**



**Figure 2-11. Flow Diagram for Direct Use Component of Proposed Action.**

### **2.3.5 Reinjection of Cooled Geothermal Fluid**

After use in the power plant and the direct-use application, the cooled geothermal fluid would be reinjected back into the geothermal resource. The temperature of the cooled geothermal fluid to be reinjected would depend on whether both components of the Proposed Action (power plant and direct-use application) are constructed, or only a single component is constructed (either the power plant or the direct-use application).

**Reinjection from Both Power Plant and Direct-Use Application.** The Proposed Action involves the construction of both the power plant and the direct-use application. The 140°F (60°C) geothermal fluid exiting the power plant would be used in the direct-use application to heat the water for the hatchery tanks. The temperature of the geothermal fluid exiting the direct-use application would be 100°F (38°C). This fluid would be mixed with the 40°F to 75°F (4°C to 24°C) blowdown water from the cooling tower. Since the flow rate of the blowdown water is 30 gpm (114 lpm), or less than 3% of the total mixed fluid flow rate, the temperature of the reinjected fluid would be essentially the same as the temperature of the cooled geothermal fluid (approximately 100°F (38°C)) (Seawright 2002).

The reinjection well would be sited at a distance to the north-northwest of the AmeriCulture site on leased land that is owned and controlled by the New Mexico State Land Office (NMSLO). The NMSLO also owns and controls the mineral rights for this land. The concern of the NMSLO is that the cooled geothermal fluid should not be reinjected into an area where the geothermal fluid in the ground is hotter. This would avoid any cooling of the resource. For the implementation of both components of the Proposed Action, the point where the temperature of the fluid to be reinjected equals the temperature of the geothermal fluid in the ground is currently calculated to be approximately 3,400 ft (1,000 m) north-northwest of the hatchery. An injection well would be drilled at this point; a new spent geothermal fluid pipeline built from the power plant to the reinjection well site, and an injection pump installed (as shown in Figure 2-6). The new spent geothermal fluid pipeline would be suspended aboveground on posts or blocks to allow the pipe room to expand and contract with the heat from the spent geothermal fluid. The reinjection well is planned to have a surface casing of 13-3/8 in. (34 cm) surface casing to a depth of around 150 ft. (46 m). The well would have 9-5/8 in. (24 cm) punch perforated casing below the depth of 150 ft. (46 m) throughout the injection interval. The planned injection interval would be around 200 to 300 ft. (60 m to 90m). The total well depth would be between 350 and 450 ft. (107 m and 137 m).

**Reinjection from Power Plant Alone.** The cooled geothermal fluid from the power plant has a temperature of approximately 140°F (60°C) and a flow rate of approximately 1000 gpm (approximately 3,800 lpm). This fluid would be mixed with the 40°F to 75°F (4°C to 24°C) blowdown water from the cooling tower. Since the flow rate of the blowdown water is (30 gpm (114 lpm)) or less than 3% of the total mixed fluid flow rate, the temperature of the reinjected fluid would be essentially the same as the temperature of the cooled geothermal fluid (approximately 140°F (60°C)) (Seawright 2002).

For implementation of the proposed power plant alone, the temperature of the cooled geothermal fluid to be reinjected (140°F (60°C)) would be approximately 40°F (22°C) hotter than the fluid would be if both the power plant and the direct-use application (100°F (38°C)) were implemented. Therefore, the reinjected fluid would be hotter than the geothermal fluid in the ground at the planned location of the reinjection well. This plan would still satisfy NMSLO's concern over cooling the resources by injected fluid cooler than the geothermal fluid in the ground at the point of injection. However, should NMSLO disagree, the reinjection well may have to be located closer to the AmeriCulture site along the path of the proposed reinjection pipeline. The exact location would depend on coordination with the NMSLO and the lease holder.

**Reinjection from Direct-Use Application Alone.** The geothermal fluid exiting the direct-use application at the hatchery would be cooled to approximately 130°F (54°C). Without the power plant there would be no cooling towers and no blowdown water. The temperature of the reinjected fluid would be approximately 130°F (54°C).

For implementation of only the direct-use application, the temperature of the cooled geothermal fluid (130°F (54°C)) would be 30°F (16°C) hotter than the fluid would be if both the power plant and the direct-use application (100°F (38°C)) were implemented. Therefore, the reinjected fluid would be hotter than the geothermal fluid in the ground at the planned location of the reinjection well. This plan would still satisfy NMSLO's concern over cooling the resources by injected fluid cooler than the geothermal fluid in the ground at the point of injection. However, should NMSLO disagree, the reinjection well may have to be located closer to the AmeriCulture site along the path of the proposed reinjection pipeline. The exact location would depend on coordination with the NMSLO and the lease holder.

Irrigation use of geothermal water is not being considered at this time. While it is possible to use cooled geothermal water for the irrigation of certain crops, the relatively high dissolved solids content (approximately 1,000 ppm) makes the water less suitable than water from the Animas Valley underground basin. Although the blowdown water originates from the Animas Valley underground basin, its TDS level would be enhanced through evaporation. Consequently, it would be well matched for reinjection along with the thermally depleted geothermal water.

## **2.4 NO ACTION ALTERNATIVE**

Under the No Action Alternative, DOE would not provide funds for either the proposed power plant or the direct-use application. Neither the proposed power plant nor the direct-use application would be built as part of a Federal Action. The fish hatchery operations would continue current operations. The use of the geothermal resource would remain the same. No information pertinent to small-scale geothermal power plants or direct-use of heat from geothermal fluid for aquaculture would be developed from this location.

It is possible that other sources of funding, including private funds, could be obtained by AmeriCulture to build either, or both, of these projects. In that case, the projects and their impacts could occur anyway.



As with any business, AmeriCulture has plans and goals for growth of the business. Currently, the DOE grants play a role in AmeriCulture's plans. If the Proposed Action was not implemented and the partial funds not awarded, AmeriCulture's plans would change. Any planned expansions would be dependent on the demand for tilapia and economic factors, including the price of power and availability of water.

## **2.5 RELATED ACTIONS**

The largest single greenhouse operation in the United States is a neighbor to the proposed project. Burgett Geothermal Greenhouses, Inc., grows cut roses using the heat and power generated from the Lightning Dock geothermal resource.

Other potential actions have been proposed in the Proposed Action area, including proposals for grants by DOE for other uses of the geothermal resource. One potential action involves drilling wells into the deep part of the geothermal resource where limited fluid is present. Water would be injected in one well and geothermal fluid would be collected at the nearby well. If this project proved successful, a power plant would be constructed to generate electricity from the resulting geothermal fluid. DOE also may consider providing future funding or partial funding for intermittent resource characterization studies in the area. These other actions are not evaluated in this EA. These actions would undergo their own review under the NEPA process if these proposals were further developed.

